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Selecting, combining, and cultivating digital deep-tech ecosystems

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Abstract: The area of interest is private-public partnerships and digital deep-tech ecosystems. This is framed with eco-system literature and system theory. The research question is: How to support exponential growth leveraged by digital disruptive technologies through selecting, combining, and cultivating digital deep-tech ecosystems within the digital disruptive domain? And more practical, how to orchestrate the innovation managers of these ecosystems? The point of departure for identifying digital deep-tech ecosystems is a Startup Genome report mapping Denmark's position in the global startup ecosystem lifecycle. Though action research the contribution of this early stage research-in-progress is a digital deep-tech ecosphere canvas illuminating a private-public partnership's contributions to the Danish ecosystems of gov-tech, fin-tech, health-tech, food-tech, robotics, and crea-tech. This is exemplified with the private-public partnership Digital Hub Denmark.

Keywords: Ecosystems; ecosphere; digital deep-tech; digital disruption; gov-tech; fin-tech; health-tech; food-tech; robotics; crea-tech.

1 A private-public partnership and a digital deep-tech ecosystem

Nearly all governments have a focus on digitalization; this is also the case for Denmark. To this end, the private-public partnership Digital Hub Denmark was launched in 2018. The vision is to become a digital frontrunner in Europe by 2023. From the beginning of 2019, I got a special research-based innovation management obligation regarding this vision; to help businesses' exponential growth leveraging digital disruptive technologies. In practice, I have helped digital businesses and entrepreneurs with this since 1999 as a board member, supervisor, consultant, or co-founder. However, I cannot help the whole nation through this relatively individual and random approach. Therefore, my focus is on nationwide ecosystems in the digital disruptive domain in which Denmark has a global niche foothold.

Ecosystems in the digital domain are often termed digital ecosystems; however, this is typically used according to the digital platform economy, where a combination of AI, big data, and IoT is leveraged. My focus is to bring exponential growth to digital businesses, and to this end, a regional ecosystem should benefit to multiple businesses. Therefore, I take my point of departure in Adner's perspective on eco-systems (Adner 2012) where they

basically are value networks, as opposed to simpler value-chains. A sustainable ecosystem is constituted by different stakeholders including costumers coupled in a value system, where each participant gains more value than any of the participants would be able to do without the system (synergy). Eco-systems can be reconfigured for success through separating, combining, relocating, adding, and subtracting ecosystem elements (Adner 2012, p. 190-191). It can be argued, that due to the digital disruptive elements of democratize, demonetize, and dematerialize (Ismail, 2014) the barriers for reconfiguration of ecosystems are lower than ever before.

It can be argued that digital ecosystems are market-driven bottom-up phenomena, as opposed to clusters that are politically implemented top-down systems. Therefore, private market actors should be highly included in governmental support of ecosystems, and to this end, private-public partnerships with private and public key partners are the most inclusive solution. As an example, the founding partners of Digital Hub Denmark are on the private side Confederation of Danish Industry, The Danish Chamber of Commerce, Finance Denmark, and The Danish Industry Foundation, and on the public side Ministry of Industry, Business and Financial Affairs, Ministry of Foreign Affairs, and Ministry Higher Education and Science (Digital Hub Denmark, 2020). The chairman of the board is partner-independent and recruited from the private sector, and the vice-chairman is the permanent secretary of the Ministry of Industry, Business and Financial Affairs.

Existing research, using the Business Model Canvas (Ostewalder & Pigneur 2010), contributes with a model of individual digital ecosystems (León et.al. 2016). And on a general level the characteristics for ‘digital business ecosystems’ are well described for a fully decentralized architecture: “No single point of failure or control; ... should not be dependent upon any single instance or actor; equal opportunity of access for all; [and (ed.)] scalability and robustness” (Nachira et.al. 2007, p. 12). Following this, digital ecosystems cannot be created top-down, they can only be identified and then selected for support. To this practical end, there seems to be a research gap for a canvas-model to select, combine, and cultivate multiple digital ecosystems in a private-public partnership with a practical focus on how to orchestrate the digital ecosystem’s innovation managers. This combined with my special research obligation is composed in a research question:

How to support exponential growth leveraged by digital disruptive technologies through selecting, combining, and cultivating digital deep-tech ecosystems within the digital disruptive domain? And more practical, how to orchestrate the innovation managers of these ecosystems?

2 A national network for digital deep-tech ecosystems

The paper addresses the very early discovery phase, where the approach is explorative and experimental. Thus, the paper reflects the first iterations of an action research process, where I am highly driven by (and reflect on) the rationalities that drive practice (Mathiassen 1997). To do this, Digital Hub Denmark hosts a national network for digital deep-tech ecosystems. Documentations are agendas, minutes, e-mails, and presentations made by members and guests.

Due 2019 I identified and selected the digital deep-tech ecosystems to support. The point of departure was a Startup Genome report funded by Digital Hub Denmark which identified

five digital eco-systems, where Denmark has a stronghold; fin-tech, health-tech, food-tech, robotics, and ed-tech (Gauthier 2019). During 2019, actors from creative industries of gaming, animation, XR, and movies formed a crea-tech ecosystem, which is also a national digital stronghold. Moreover, the Danish government annual invests 2 billion EUR in digital solutions, and to this end, they want to support the budding gov-tech ecosystem. Together, these six digital ecosystems form what I term the national digital ecosphere. Of course, these digital ecosystems are identified as a function of ecosystem size, turnover, and investments. However for selection, three extra criteria have been used; firstly an ecosystem should be formally organized, as a nationwide (preferable) not-for-profit association; secondly, these organizations should be represented by an innovation manager in the position of e.g. cluster director or CEO; and thirdly, the innovation managers must have a global, open, and integrative mindset, where all national businesses are considered as potential ecosystem participants rather than competitors.

Six digital ecosystems have been selected for the national network for digital deep-tech ecosystems: Gov-tech, fin-tech, health-tech, food-tech, robotics, and crea-tech. Ed-tech is not selected because it might be smart to include the Danish ed-tech industry in the gov-tech ecosystem. The Danish ed-tech industry is heavily driven by governmental initiatives.

One important finding of the Startup Genome report is that Denmark is positioned as a Globalizer in the global startup eco-system lifecycle (Ibid.). This is illustrated in Figure 1, where Denmark's position in the globalization phase is in the blue box. The position measured as startup-experience is based on the rate of unicorns, rate of exits, and rate of early-stage success. The important insight from the StartUp Genome report is the clear correlation between the size and resources of an ecosystem and the position in the global eco-system lifecycle (left y-axis), because this means Denmark has to scale the digital eco-systems to reach the goal of positioning Denmark in the attraction phase (yellow box). The core difference between the globalization and attraction phase is whether digital talent, start-ups, scale-ups, and investments are primarily respectively detracted or attracted to the ecosystems. Examples of digital eco-systems in the attraction phase are based in Tel Aviv, London and Stockholm (early stage). Silicon Valley is the core example of a digital eco-system in the integration phase, integrating businesses all over the world.

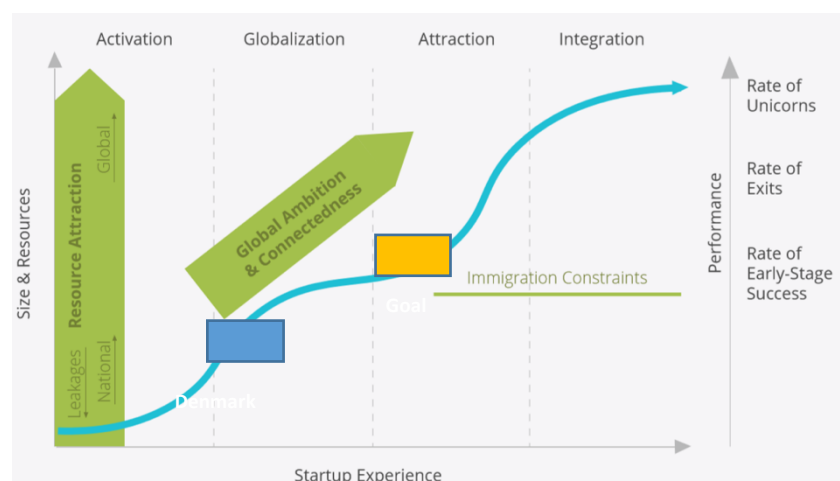


Figure 1 Denmark is in the globalization phase of the start-up eco-system lifecycle.

The vision is, as formulated with my special research obligation, to help businesses' exponential growth leveraging digital disruptive technologies. Digital disruptive technology can be defined as disruptive technology on an exponential growth trajectory regarding price-performance (Lundgaard & Rosenstand, 2019; Rosenstand et.al. 2018). The core digital disruptive technology is computer power (digital calculations) where the price-performance has been doubling annually since 1890 until today, due to the exponentially growing number of transistors in an integrated circuit every 18 months known as Moore's law, increased clock frequency, and market forces (Kurzweil 2005). To this end, I focus on businesses leveraging exponential price-performance of digital disruptive technologies in exponential business models. The idea is to enter the digital age by taking significant global market shares in the industries represented by the selected digital deep-tech eco-systems than the size of Denmark (5,8 million inhabitants) justifies with a linear growth perspective known from the industrial age. One important aspect is reducing the limitations for new growth regarding the size of the national talent mass, as it is well known that the growth of an exponential business is far from 1:1 with the number of employees (digital talents).

The mission is to move Denmark to the attraction phase, and the strategy is to 'hack' the leap between the blue and the yellow position in Figure 1 by selecting, combining, and cultivating national digital ecosystems, where Denmark has a global stronghold. Until now digital ecosystems in Denmark have been detached and limited around cities. For a small country like Denmark, with a geographical size comparable to Greater Boston this is simply inefficient in a globally competitive world. To this end, the Danish law of business promotion from 2018, is a strong incentive for national syndication of eco-systems because only one national position in each stronghold might be funded as a national cluster. Danish clusters are in the process of being appointed during 2020 and the industries represented by the six selected eco-systems except gov-tech will most probably be included in national clusters. In a way, the gov-tech industry is covered by the annually governmental expenses on digital solutions. The eco-systems will probably remain their geographical epicenters, e.g. is the epicenter of robotics is in Odense, but talent, investors, and business will be included from other parts of Denmark. In practice, this is done by syndicating eco-system players – e.g. from 2020, Odense Robotics is member of the new national Robotics Alliance association.

A coherent national digital-deep tech eco-system on a trajectory towards the attraction phase in Figure 1 is the purpose of the national network for digital deep-tech ecosystems. Digital Hub Denmark hosts meetings, where six innovation managers from the six eco-systems participate together with me and the CEO of Digital Hub Denmark, moreover special guests are invited – e.g. regarding digital talent attraction.

3 A digital deep-tech ecosphere canvas

The term ecosphere is selected because it is what is termed an 'open/closed system' for multiple ecosystems. Digital ecosystems are social systems and can thus be understood with system theory (Luhmann 1984). The digital ecosphere is closed to its surroundings because it is self-organized and structured; however, it is open to its surroundings through communication in forms of e.g. investments, the entrance and exits of talents, and tech-

alliances. A social system normally consists of multiple differentiated sub-systems communicating more or less effectively with each other. In the digital deep-tech ecosphere the six selected ecosystems are such differentiated sub-systems. Elaborating the system theory is outside the scope of this paper; however, the point here is that it is a relevant tool for the understanding of a digital eco-sphere.

To support exponential growth leveraged by digital disruptive technologies through selecting, combining, and cultivating digital deep-tech ecosystems within the digital disruptive domain, I have created a canvas for a digital deep-tech ecosphere. In an iterative action research process, I have shared, discussed, and developed the canvas with the ecosystem innovation managers, with good coworkers in Digital Hub Denmark, and with other innovation researchers. To this end, it is a highly dynamic canvas supporting the co-creation of the ecosphere forming. The last version from April 2020 is illustrated in Figure 2 and has (in an earlier Danish version) been presented to Digital Hub Denmark's board illuminating the private-public partnership.

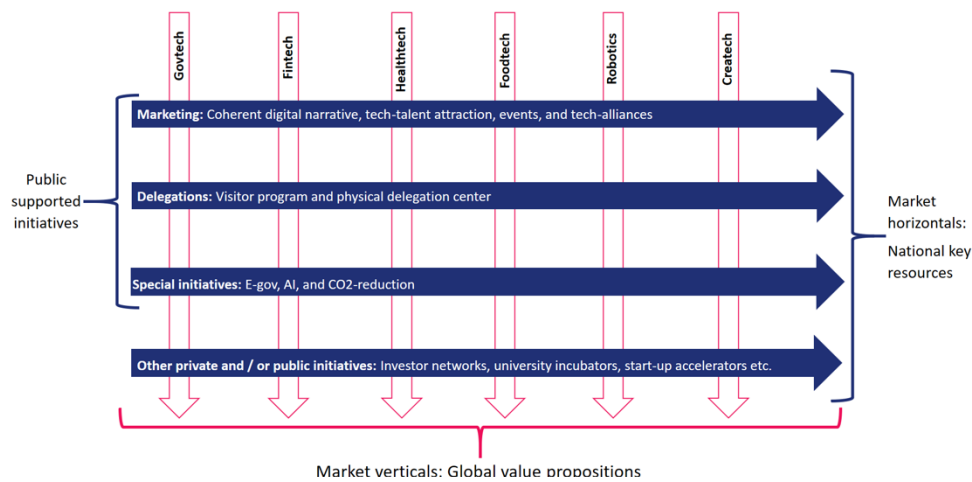


Figure 2 Digital deep-tech ecosphere canvas with Digital Hub Denmark.

The canvas is constituted by intertwined market verticals and horizontals. The selected digital ecosystems constitute the market verticals where the eco-sphere owners have identified ecosystems representing industries with strongholds in the form of global value propositions – “bundle of products and services that create value for a specific customer segment” (Ostewalder & Yves, 2010, p. 22). E.g. the global public sector is the specific customer to gov-tech businesses.

The market horizontal should meet a need for a wide range of businesses across different industries. Thus, they must be shared agendas across the participating ecosystems cultivating and combining them. The public supported initiatives in Figure 2 are aligned with the Digital Hub Denmark's private-public owners' decision on the goals for 2020 within marketing, delegations, and special initiatives. The canvas is open to other horizontal players like investor networks, university incubators, and start-up accelerators. To this end, the market horizontals can be considered national key resources to the ecosphere “... describing the most important assets required to make a business model [of ecosystems (ed.)] work” (Ostewalder & Yves, 2010, p.34). To this end, the goal is what I term ecosystem efficiency. An example of a market horizontal is tech-talent attraction,

where Digital Hub Denmark is mapping the digital talent in Denmark. Moreover, foreign talent pools are identified with pull and push factors for future talent attraction. Digital talents such as data-scientists can contribute to the whole digital deep-tech ecosphere, and because talent attracts talent it is important to illuminate the size of the whole ecosphere instead of a single ecosystem. A practical implication is a new design of Digital Hub Denmark's homepage as a portal illuminating the ecosphere and its ecosystems with a specific focus on talent attraction.

The canvas illuminates where the public supported initiatives make a difference to the individual eco-systems. An example is a tech-alliance with an initiative in Tokyo, where it is decided to bring 10-20 fin-tech and 5-10 robotics business. One important agenda is supporting a potential interdisciplinary corporation between fintech and robotics – e.g. the converging drones and insurance solutions. To this end, the ecosphere canvas also supports the orchestrating of the innovation managers of the selected digital deep-tech ecosystems.

4 Conclusion

The digital deep-tech eco-sphere canvas support exponential growth leveraged by digital disruptive technologies as a tool for selecting, combining, and cultivating digital deep-tech ecosystems within the digital disruptive domain. And more practical it can help to orchestrate innovation managers of the selected ecosystems.

The canvas might also be applied to other ecospheres in other industries and non-digital sectors? However as stated, reconfiguration of ecosystems is more efficient when they are (potential) digitally connected. E.g. physical distance is a much lesser obstacle. The canvas might also be useful on other levels like EU or regional. The canvas needs to be applied to other ecospheres to be tested.

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- CEO Thomas Krogh Jensen, Copenhagen Fintech (fin-tech)
- CEO Jesper Grønbæk, Health Tech Hub, Copenhagen (health-tech)
- Director Anne-Marie Hansen, Agro Food Park (food-tech)
- Cluster Director Mikkel Christoffersen, Robotics Alliance (robotics)
- CEO Jan Neiiendam, Vision Denmark (crea-tech)

6 Areas for feedback

- Please, provide any other similar cases from other regions or nations.
- Please, suggest relevant applied research on digital deep-tech ecosystems.
- Please, provide suggestions on research design and strategy for analysis.

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